

Senior High School Students Perception on Sustainability Literacy in Biology Learning

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Abstract: The Sustainable Development Goals (SDGs) are a global partnership's urgent call to action from all developed and developing countries to build a sustainable future. Students play an essential role in achieving this goal because they are the primary objects of formal education who can be involved through concrete actions and appropriate and effective decision-making. In order to achieve this goal, sustainable development capability and capacity, as measured by sustainability literacy, are required. The purpose of this study is to gather information about students' initial perceptions of environmental change subject in relation to students' sustainability literacy. The method used is a descriptive method with a quantitative approach. This study was conducted in February 2023 on 34 students from grade XI in SMAN 1 Bandung who had already completed the subject. Students' sustainability literacy was assessed using a questionnaire. Descriptive analysis was used to examine the data. Finding indicated that the indicator of knowledge was worth 43% within very bad category, knowledge of skills had a value of 44% with a very bad category as well and mindset was worth 55% with a bad category. As a result, it is possible to conclude that students' sustainability literacy is of very bad quality.

Keywords: Student Perception; Sustainability Literacy; Environmental Change; Sustainable Development Goals

Introduction

Long-Term Sustainable Developments (SD) are becoming a major issue around the world. Sustainable development is concerned with long-term environmental, political, social, and economic development. Despite significant progress made by many parties, challenges such as poverty, biodiversity loss, and climate change can still be found today, implying that there are many areas where sustainable development actions must be taken. Individual action requires the current generation to develop their abilities and capacities toward sustainable development. Regardless of differences in the application of existing concepts such as ability, competence, and awareness, the general quality of individual sustainable development can be seen in the knowledge, mindset, and skills that

enable an individual to build a sustainable future and assist in making effective decisions for this purpose (United Nations, 2018). Individual changes in knowledge, attitudes, and behavior are required to achieve sustainable development (Buckler & Creech, 2014).

Building a sustainable future is inextricably linked to education. Education has an important role in empowering individuals and future decision-makers to face the difficult and critical challenges of the twenty-first century, such as enabling change and collectively crafting a sustainable future. Higher education has a unique role to play in teaching and generating change agents in this agenda. The connection between higher education and sustainability is more important than ever. SDG 4 on Quality Education emphasizes this. (Décamps et al., 2017).

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Students play a critical role in this individual action because they are the primary objects of formal education and agents of change in sustainable development, and they can participate through concrete actions and appropriate and effective decision-making. Over the last two decades, there has been growing recognition and political agreement on the role of education as the primary agent for transforming today's society into a more sustainable, just, and equal society. Education for Sustainable Development (ESD) is not only one of the 17 Sustainable Development Goals (SDGs) but it is also a means to achieve other SDG targets. Goal 4 of the SDGs specifically addresses the role of ESD in this regard. ESD emphasizes the development of adequate knowledge, a positive attitude, and proficient skills. Many activities are being carried out in this regard in relation to ESD policies (UNESCO, 2014).

Education for Sustainable Development (ESD) is defined as a strategy for promoting critical thinking and competency development as a means of achieving the Sustainable Development Goals (SDGs) (Olsson et al., 2019). ESD promotes more sustainable changes in knowledge, skills, values, and attitudes; additionally, ESD aims to empower and equip students to meet their needs through a balanced and integrated approach to sustainable dimensions, namely environmental, social, and economic (Leicht et al., 2018). According to Olsson (2019), ESD plays an important role in increasing students' knowledge and competence to overcome future problems. In line with that Pauw et al. (2015) stated that education has the potential to empower students' action competencies which are linked to knowledge and willingness to act. Education, particularly science education, must play a critical role in promoting sustainability by linking learning to opportunities for action, particularly collaborative action within local communities (Trott, 2017).

In the interest of accomplishing long-term development goals through education, a guide is required for everyone who shares the same vision. The guide is identified as sustainability literacy. Sustainability literacy is described as the understanding, skills, and mindset that motivates a person to commit to establishing a future that is sustainable and encourages him to make the right and effective decisions to that end (Decamps, 2017). In other words, sustainability literacy is a set of knowledge, skills, and mindsets that can inspire people to create a more sustainable future. Someone who has been educated in sustainability literacy already has the provisions to build a bright and sustainable future in accordance with global sustainable development goals. To develop individuals with good sustainability literacy, skills and competencies are required to shape a sustainable future, such as

awareness of environmental change requires the ability to understand problems contextually in large ecosystems comprised of human, political, economic, ecological, cultural, and social systems (Ansari & Stibbe, 2009).

The above results emphasize the necessity of strengthening each citizen's sustainability literacy so that they can demonstrate competencies and attitudes of respect for the present while thinking about the future, conserving it in a mindful and intentional manner (Serpa & Jose Sa, 2019). The importance of sustainability literacy is such that there are examinations to assess it. Sulitest (Sustainability Literacy Test), for example, is a globally developed and frequently used open web application (Décamps et al., 2017). This test, which may be taken online by higher education students, intends to identify this population segment's understanding of local and global issues related to sustainable development, in order to assess, know, spread and promote literacy in this field (Storey et al., 2017). The Sulitest is founded on a simple concept: for a sustainable future, we need a world full of individuals who are aware of sustainability and have core literacy (Decamps, 2017).

Sustainable development, in which the development of sustainability is paramount through the process of its learning (Waring, 2017), entails a shift in the societal paradigm, in which "Sufficiency" is a core value dimensions, such as the economic, environmental, technological, cultural, societal and political ones, in both the production and consumption of goods and services (Burns, 2016). A pertinent point raised by this topic is the necessity to distinguish between education and sustainable development (Aragon-Correa et al., 2017). This positioning appears to refer to something close to sustainability literacy, given the necessity to acquire competencies that are intentionally used as social learning (Lowther & Sellick, 2016).

Ansari and Stibbe (2009) offer an interesting perspective on the learning of sustainability literacy by associating the concept of sustainability with the skills and competencies required for its literacy, as depicted in Figure 1. This new educational orientation entails the adoption of a self-directed, participatory and collaborative learning, oriented towards problem-solving, that is inter-disciplinary and trans-disciplinary, that connects formal and informal learning, and that places the student at the center of this new form of access to knowledge (UNESCO, 2017).

In this centrality of teaching and learning process in education for a culture of sustainability (Cebrián & Junyent, 2015), higher educational institutions bear a number of social, environmental and economic responsibilities. Sustainable development in universities entails various interconnected factors in addition to

teaching and learning (Hugé et al., 2016), and changing the formal curriculum is not enough (Cicmil et al., 2017). It is also required: “(1) sustainability-focused education and teaching; (2) sustainability-focused research; (3) campus operations and environmental management; and (4) community engagement around sustainability issues” (Bessant et al., 2015).



Figure 1. Sustainability literacy and associated skills and competencies

In connection with the aforementioned issues, the researcher conducted a preliminary study at one of Bandung's high schools. According to the findings of an interview with one of the biology teachers, the goals of sustainable development and sustainability literacy have not been properly and effectively implemented in the classroom. Since the implementation of the Kurikulum Merdeka in schools, biology learning in schools able to focused on essential material in order to allow for in-depth learning of basic competencies such as sustainability literacy. The fundamental competencies to be mastered can be attained by implementing project-based learning for the development of related soft skills and character in accordance with the profile Pelajar Pancasila.

Therefore, efforts to empower sustainability literacy in the learning process in Indonesia should be able to carried out optimally in school. Thus the purpose of this study is to describe the sustainability literacy of class XI students of SMA Negeri 1 Bandung in Biology learning.

Method

The study's main goal was to assess students' levels of sustainability literacy at a specific institution of higher learning. The research method used was descriptive research with a quantitative approach. Because it can be interpreted as a method that does not provide processing, manipulation, or modification of the sample used, a descriptive method does not require a control class or experimentation. The collected data were analyzed and described to explain the study subjects' conditions. The study design provides a snapshot of students' current level of sustainability literacy. It also describes the situation as it currently exists so that plans for change can be developed if the picture depicted by the study is not desirable; and it can also serve as a foundation for more in-depth studies. Research design and method should be clearly defined.

This research was conducted at February 2023. This study was conducted offline by providing questionnaires to research subjects. This research was conducted at SMAN 1 Bandung. The class that is used as a research sample is the class that already undergo the materials. This is because the test that will be given is an sustainability literacy test that is modified with biology subject matter. The materials used are environmental change materials. The population in this study were students of grade XI. This research was conducted in the 2022/2023 school year. The sample in this study is all students in the classroom who have been selected to be given a sustainability literacy questionnaire. The research sample was taken by convenience sampling with the determination of research subjects based on teacher and school management considerations.

The instrument used for data collection in this research is sustainability literacy questionnaire. Sustainability literacy in this study refers to students' literacy level in terms of sustainability, which includes knowledge, knowledge of skills, and mindset. Each aspects has themes with several number of subjects. Sustainability literacy is assessed using a test consisting of 15 multiple-choice questions based on the Sulli test indicator (Décamps et al., 2017), which is tailored to the knowledge level of high school students. This instrument aims to obtain information on students' level of sustainability literacy in the three existing aspects. Indicators adapted from UNESCO's Global Education Monitoring Report by Aurélien Decamps (2017). For more in-depth information on questionnaires compiled according to sustainability literacy, indicators can be seen in Table 1.

Table 1. Sustainability Literacy Indicators

Indicators	Themes	Subjects
Knowledge	Sustainable humanity and ecosystems on planet Earth	1. Ecosystems: Biosphere, global and local ecosystems, interdependent and diverse community of life, supporting cycles, system closed (materials)/ open (energy), etc.
		2. Sustainability: Definition of Sustainability/ Sustainable development
	Global and local human-constructed systems to answer people’s needs	3. Local and global social structures and governance: paradigms, positive results negative impacts; laws; how organizations work; land use; gender equality; etc.
	Transitions towards sustainability	4. Within local and global economic systems, zooms on: Water, Energy and Food
Knowledge of Skills	We each have roles to play to create and maintain individual & systemic changes	5. Initiatives towards sustainability ... more from institution/international level (like UN MDGs, Global Compact, GIEC, GRI, ISO 26 000, ESD, etc.)
		6. Examples and ideas we can learn from: case studies of successes or failures; technological, strategic, or social innovations.
	Personal skills	7. How does one become aware of his own roles and impacts...? whoever “one” is (individual, organization, south, north, etc.)
		8. How does one efficiently act to create both individual and system change...? whoever “one” is (individual, organization, south, north, etc.)
Working with others	Think & act systemically	9. Capacity for empathy, compassion, solidarity; Futures-oriented and strategic thinking
		10. Catalyzing/ managing change; Inspire a shared vision; Enable/Motivating others to act/participate
	11. Teamwork; Work in multi-cultural and interdisciplinary (diverse) settings; Participatory skills, decision-making; Conflict resolution skills/consensus building; Focus on process, dialogue, listening	
Mindset	Mindset towards sustainability	12. Ability to put in practice systems thinking concepts; identify and use leverage points
		13. Ability to understand formal and informal structures, power dynamics, and interactions
		14. Humans as part of nature and not separate from it
		15. Active commitment to solve sustainability problems

Source: (Decamps, 2017)

This study was carried out in the biology class of 11th grade senior high school students using a qualitative research design, which consisted of five steps to analyze students' sustainability literacy. (Maxwell, 2012). The research flow is used as a reference or guideline for carrying out the research agenda, allowing researchers to conduct their research in a structured manner and on time. The first step was to identify the goals. At this step, the researcher address a specific set of concerns such as the issues about sustainability literacy in senior high school and why should we care about the results. Based on cognitive development, 11th grade students in senior high school have already reached high levels of abstract thinking and problem solving. They have also previously studied science, particularly biology, and thus have prior knowledge of the concept of environmental change.

The second step was to define the conceptual framework. At this stage, the researcher studies and comprehends the theories that guide and reference from a wide range of literature, preliminary studies, and even personal experiences, thereby supplementing the treasury of theories, beliefs, and prior research findings toward the issues that have been raised. The third step was to distinguish the research questions. At this point, the researcher wishes to gain a greater understanding of the state of sustainability literacy among senior high school students.

The fourth step involved method selection, which is an essential part of the process. Approaches and techniques used in data collection and analysis were found through the selection of settings, participants, data collection times and locations, and other data sources such as documents. The technique used is to distribute questionnaires to several students to answer

questions about sustainability literacy factors such as knowledge, skill knowledge, and mindset about a sustainable future. The final step is to assess the validity of the data and analyze it based on the findings, which infers the results from the data acquired.

A questionnaire instrument with 15 questions is used to gather data on student perceptions of sustainable literacy. Descriptive analysis was performed on the study findings through an explanation of the mean (average) of students' views of the teacher's and student learning activities. The following formula can be used to calculate the result score of the sustainability literacy as mentioned in Muhlis et al. (2022).

$$Indicator = \Sigma \frac{respondent's\ answer\ score}{maximum\ score} \times 100 \quad (1)$$

The findings are then converted into sustainability literacy criteria, as shown in Table 2.

Table 2. Sustainability Literacy Criteria Score

Value	Criteria
< 54%	Very Bad
55-59%	Bad
60-75%	Enough
76-85%	Good
86-100%	Excellent

Source: (Fikriyah & Ahied, 2022)

Result and Discussion

By using a questionnaire instrument with 15 questions, students' perception of sustainable literacy is gathered. The results of the data analysis of the student's sustainability literacy profile are given.

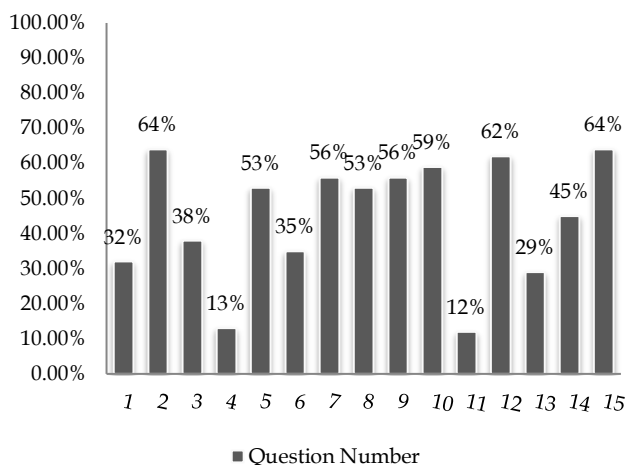


Figure 2. Percentage of Student's Answers

According to the findings regarding the students' answers in Figure 2, percentage of correct students' answers in question item 1 is 32%; item 2 is 64%; item 3

is 38%; item 4 is 13%; item 5 is 53%; item 6 is 35%; item 7 is 56%; item 8 is 53%; item 9 is 56%; item 10 is 59%; item 11 is 12%; item 12 is 62%; item 13 is 29%; item 14 is 45% and item 15 is 64%. It was discovered that the majority of students accurately answered question number 2 about the definition of sustainability and question number 15 about commitment to solving sustainability problems. Meanwhile, mostly students answered incorrectly in the question number 4 and 11, related to the indicator of knowledge and knowledge of skills. It is assumed that mostly students don't have enough knowledge and knowledge of skills in related to sustainability literacy. The following are presented the results of the data analysis based on each indicator.

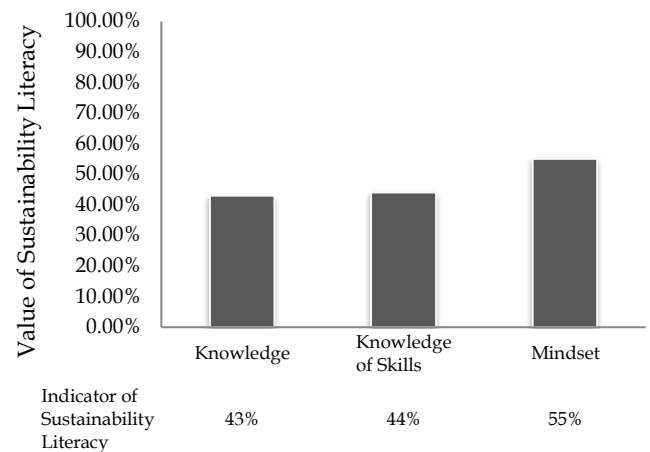


Figure 3. Student Sustainability Literacy Results Based on Indicator

Figure 3 illustrates how the outcomes of sustainability literacy varied in each indicator. According to the research findings displayed in Figure 2, the last indicator of sustainability literacy, namely mindset, gets a percentage of 55% while the aspect with the lowest percentage, namely knowledge gets of percentage of 43%. With only percentage of 44%, the other indicator, knowledge of skills, did not have a very high percentage either.

Mindset obtained the highest percentage of the indicator. This indicator is at the highest percentage among other indicators because it is easier for students to grasp the mindset about sustainability based on phenomenon that presented in the problem. The sustainability mindset itself is a way of thinking and being that stem from a broad understanding of the ecosystem's manifestations, social sensitivity, and an introspective focus on one's personal values and higher self, that manifests itself in actions for the greater good of the whole (Kassel & Rimanoczy, 2018). Although it boasts the highest percentage but it's still in bad category. In order to develop a sustainability mindset a

framework that included specific content areas such as ecological worldview, system thinking, spiritual intelligence and emotional intelligent (Kassel et al., 2016) should be provided at school for students to channel their feelings and energy into some tangible action.

The second highest indicator is the knowledge of skills. Its fall upon very bad criteria with percentage of 44%. Knowledge of skills is the abilities of a person whose aim is to support the achievement of sustainable development, human rights, gender equality, recognition of culture of peace and appreciation of cultural diversity that contributes to sustainable development (UNESCO, 2017). The skills indicator is divided into three parts, namely personal skills, working with others and think and act systematically. To boast these skills, a syllabus that cater to combine these skills in classroom need to be implemented.

The last indicator that fairly have a poor percentage is knowledge. This could happen when students are not exposed to sustainability either in school or real life. Knowledge in sustainability will help students understand the situation, perspectives and needs of people living in their country or other parts of the world or belonging to another generation. Knowing about sustainability attempts to comfort students with ethical issues in which they must decide what standard and codes society should adopt in order to frame human actions that seek higher economic well-being while preserving the natural environment. As a result, when determining which resources to use for economics, social and environmental challenges, students will need to examine and develop a code of ethics for sustainability, both in the classroom and in real life. (Saitua-Iribar et al., 2020).

Based on the result above, at the institutional level, in the same way that Bizerril et al. (2018) conclude in their study on sustainability in higher education in Portuguese-speaking countries that higher education institutional levels culture is a critical factor in the process of promoting sustainability literacy in class. This reflexivity also requires an understanding that the formal dimension alone is insufficient to promote sustainability literacy (Serpa & Jose Sa, 2019).

Considering the informal dimension is also critical in learning process in school Borges et al. (2017), O'Brien et al. (2013) point out that in the current positioning of teaching institutions, there is a tendency to envision scientific knowledge as "a truth that needs to be communicated to 'users', often ignoring other types of knowledge or perspectives", in an often-uncritical stance towards knowledge. Thus, the authors propose for a new paradigm approach in the shift from "science for society" to "society with society".

This new approach necessitates that higher education institutions give room for reflection and questioning, experiential learning, and the development of personal competences, such as the ability to analyze, think critically and value diversity to its students. However, there is still some doubt about the usefulness of this divergent positioning in respect to the existing way of learning (Cicmil et al., 2017). In this line, RE Cotton and Alcock (2013) argue that higher education plays an important role in environmental sustainability by encouraging students to develop cognitive skills in an institutional environment characterized by the defense of environmental values and behaviors and the promotion of the development of ideological commitment in institutional actors. Colucci-Gray et al. (2006) validate this notion of complexity and difficulty in the development of sustainability literacy along with the teaching of science itself.

All this must be considered when promoting anticipatory core competencies like as critical thinking, self-awareness and integrated problem-solving, which are embodied in the following SDGs: (i) 18.3 The learner can engage with new visions and models of a sustainable, inclusive economy and decent work; (ii) 12.2. The learner can distinguish between needs and wants to reflect on their own individual consumer behavior in light of the needs of the natural world, other people, cultures and countries, and future generations, and (iii) 13.3. The learner can anticipate, estimate and assess the impact of personal, local and national decisions or activities on other people and world regions.

To summarize, education for the formation of a culture of sustainability literacy is indeed a complicated process that produces numerous internal and external uncertainties in higher education (Hugé et al., 2016). Hence, it is not possible to provide a unique recipe/method for managing this process (UNESCO, 2017), given that sustainability is both a scientific process, but also a social and political one (Cicmil et al., 2017). To promote sustainability literacy in higher education, a transformation in the learning and teaching process is required as well as a cultural and societal transition. However, more than that, there is also a need for change in many higher education institutions (von Blottnitz et al., 2015).

These concerns about sustainability should naturally also be present in higher education. It is important that the learning and teaching process of sustainability literacy in higher education is taken as a systematic and anticipatory transdisciplinary approach, in the sense of ensuring, through active learning methodologies, that students attain competencies that

will enable them to consolidate a lasting environmental awareness (O'Brien et al., 2013).

Conclusion

Based on the findings and discussions, it is possible to conclude that the sustainability literacy of students at senior high school 1 Bandung, specifically knowledge indicators, has a value of 43% in the very bad category, knowledge of skills has a value of 44% in the same category, and mindset toward sustainability has a value of 55% in the bad category. These concerns about sustainability should naturally be present in higher education. It is critical that the learning and teaching process of sustainability literacy in higher education be viewed as a systematic and anticipatory transdisciplinary approach, with the goal of ensuring that students acquire competencies that will enable them to consolidate a lasting sustainability literacy through active learning methodologies. Therefore, more study on efforts to enhance students' sustainability literacy in three areas is required.

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I wrote this article myself. Starting from the preparation activities, data collection, data processing with IBM SPSS 26 software, preparation of the article framework (introduction, methods, results & discussion, to conclusions), and finally the article publications activities.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

- Ansari, W., & Stibbe, A. (2009). Public Health and the Environment: What Skills for Sustainability Literacy – And Why? *Sustainability*, 1(3), 425–440. <https://doi.org/10.3390/su1030425>
- Aragon-Correa, J. A., Marcus, A. A., Rivera, J. E., & Kenworthy, A. L. (2017). Sustainability Management Teaching Resources and the Challenge of Balancing Planet, People, and Profits. *Academy of Management Learning & Education*, 16(3), 469–483. <https://doi.org/10.5465/amle.2017.0180>
- Bessant, S. E. F., Robinson, Z. P., & Ormerod, R. M. (2015). Neoliberalism, new public management and the sustainable development agenda of higher education: History, contradictions and synergies. *Environmental Education Research*, 21(3), 417–432. <https://doi.org/10.1080/13504622.2014.993933>
- Bizerril, M., Rosa, M. J., Carvalho, T., & Pedrosa, J. (2018). Sustainability in higher education: A review of contributions from Portuguese Speaking Countries. *Journal of Cleaner Production*, 171, 600–612. <https://doi.org/10.1016/j.jclepro.2017.10.048>
- Borges, J. C., Ferreira, T. C., Borges de Oliveira, M. S., Macini, N., & Caldana, A. C. F. (2017). Hidden curriculum in student organizations: Learning, practice, socialization and responsible management in a business school. *The International Journal of Management Education*, 15(2), 153–161. <https://doi.org/10.1016/j.ijme.2017.03.003>
- Buckler, C., & Creech, H. (2014). *Shaping the Future We Want: UN Decade of Education for Sustainable Development (2005-2014) : Final Report*. UNESCO.
- Burns, T. R. (2016). Sustainable development: Agents, systems and the environment. *Current Sociology*, 64(6), 875–906. <https://doi.org/10.1177/0011392115600737>
- Cebrián, G., & Junyent, M. (2015). Competencies in Education for Sustainable Development: Exploring the Student Teachers' Views. *Sustainability*, 7(3), 2768–2786. <https://doi.org/10.3390/su7032768>
- Cicmil, S., Gough, G., & Hills, S. (2017). Insights into responsible education for sustainable development: The case of UWE, Bristol. *The International Journal of Management Education*, 15(2), 293–305. <https://doi.org/10.1016/j.ijme.2017.03.002>
- Colucci-Gray, L., Camino, E., Barbiero, G., & Gray, D. (2006). From scientific literacy to sustainability literacy: An ecological framework for education. *Science Education*, 90(2), 227–252. <https://doi.org/10.1002/sce.20109>
- Decamps, A. (2017). *Analysis of Determinants of a Measure of Sustainability Literacy UNESCO*. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000259581>
- Décamps, A., Barbat, G., Carteron, J.-C., Hands, V., & Parkes, C. (2017). Sulitest: A collaborative initiative to support and assess sustainability literacy in higher education. *The International Journal of Management Education*, 15(2), 138–152. <https://doi.org/10.1016/j.ijme.2017.02.006>
- Fikriyah, A., & Ahied, M. (2022). Analyzing students' science process skills through mobile learning using virtual laboratory. *Biosfer*, 15(2), 214–230. <https://doi.org/10.21009/biosferjpb.24513>

- Hugé, J., Block, T., Waas, T., Wright, T., & Dahdouh-Guebas, F. (2016). How to walk the talk? Developing actions for sustainability in academic research. *Journal of Cleaner Production*, 137, 83–92. <https://doi.org/10.1016/j.jclepro.2016.07.010>
- Kassel, K., & Rimanoczy, I. (2018). *Developing a Sustainability Mindset in Management Education* (1st ed.). Routledge.
- Kassel, K., Rimanoczy, I., & Mitchell, S. F. (2016). The Sustainable Mindset: Connecting Being, Thinking, and Doing in Management Education. *Academy of Management Proceedings*, 2016(1), 16659. <https://doi.org/10.5465/ambpp.2016.16659abstract>
- Leicht, A., Heiss, J., & Byun, W. J. (2018). *Issues and trends in Education for Sustainable Development*. UNESCO Publishing.
- Lowther, J., & Sellick, J. (2016). Embedding sustainability literacy in the legal curriculum: Reflections on the Plymouth model. *The Law Teacher*, 50(3), 307–320. <https://doi.org/10.1080/03069400.2016.1240919>
- Maxwell, J. A. (2012). *Qualitative Research Design: An Interactive Approach* (3rd ed., Vol. 41). Sage Publications.
- Muhlis, N. F., Yani, A., Suryanni, S. D., & Upe, A. (2022). Environmental literacy profile of senior high school in Mowewe Southeast Sulawesi. *Biosfer*, 15(2), 313–319. <https://doi.org/10.21009/biosferjpb.26787>
- O'Brien, K., Reams, J., Caspari, A., Dugmore, A., Faghihimani, M., Fazey, I., Hackmann, H., Manuel-Navarrete, D., Marks, J., Miller, R., Raivio, K., Romero-Lankao, P., Virji, H., Vogel, C., & Winiwarter, V. (2013). You say you want a revolution? Transforming education and capacity building in response to global change. *Environmental Science & Policy*, 28, 48–59. <https://doi.org/10.1016/j.envsci.2012.11.011>
- Olsson, D., Gericke, N., Boeve-de Pauw, J., Berglund, T., & Chang, T. (2019). Green schools in Taiwan – Effects on student sustainability consciousness. *Global Environmental Change*, 54, 184–194. <https://doi.org/10.1016/j.gloenvcha.2018.11.011>
- Pauw, J., Gericke, N., Olsson, D., & Berglund, T. (2015). The Effectiveness of Education for Sustainable Development. *Sustainability*, 7(11), 15693–15717. <https://doi.org/10.3390/su71115693>
- R.E. Cotton, D., & Alcock, I. (2013). Commitment to environmental sustainability in the UK student population. *Studies in Higher Education*, 38(10), 1457–1471. <https://doi.org/10.1080/03075079.2011.627423>
- Saitua-Iribar, A., Corral-Lage, J., & Peña-Miguel, N. (2020). Improving Knowledge about the Sustainable Development Goals through a Collaborative Learning Methodology and Serious Game. *Sustainability*, 12(15), 6169. <https://doi.org/10.3390/su12156169>
- Serpa, S., & Jose Sa, M. (2019). Exploring Sociology of Education in the Promotion of Sustainability Literacy in Higher Education. *The Journal of Social Sciences Research*, 51, 101–116. <https://doi.org/10.32861/jssr.51.101.116>
- Storey, M., Killian, S., & O'Regan, P. (2017). Responsible management education: Mapping the field in the context of the SDGs. *The International Journal of Management Education*, 15(2), 93–103. <https://doi.org/10.1016/j.ijme.2017.02.009>
- Trott, C. D. (2017). *Engaging Key Stakeholders in Climate Change: A Community-Based Project for Youth-Led Participatory Climate Action*. Colorado State University.
- UNESCO. (2014). *UN Decade of ESD*. United Nations Educational, Scientific and Cultural Organization. Retrieved from <https://en.unesco.org/themes/education-sustainable-development/what-is-esd/un-decade-of-esd>
- UNESCO. (2017). *Education for sustainable development goals, Learning objectives*. United Nations, Educational, Scientific and Cultural Organization.
- United Nations. (2018). *Raising awareness and assessing sustainability literacy on SDG 7*. Retrieved from <https://sustainabledevelopment.un.org/sdinaction/hesi/literacy>
- von Blottnitz, H., Case, J. M., & Fraser, D. M. (2015). Sustainable development at the core of undergraduate engineering curriculum reform: A new introductory course in chemical engineering. *Journal of Cleaner Production*, 106, 300–307. <https://doi.org/10.1016/j.jclepro.2015.01.063>
- Waring, M. (2017). Research literacy: Contextual affordances and the ongoing quest for sustainability and research quality. *Research Papers in Education*, 32(4), 538–539. <https://doi.org/10.1080/02671522.2017.1322354>